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COVID-19 outbreak and increased risk of amblyopia and epidemic myopia: Insights from EUROCOVCAT group

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Abstract

The most common cause of vision impairment in children is amblyopia. It is defined as impaired visual acuity in one or both eyes that is present with no demonstrable abnormality of the visual pathway and is not immediately resolved by wearing glasses. After the World Health Organization (WHO) recognized COVID-19 as a global pandemic on March 11, 2020, widespread changes and restrictions to social and sanitary practices have presented significant issues in access to eye care during the COVID-19 pandemic. A reduction of more than 80% in pediatric eye care volume up to its total cessation has been observed in different departments. In this scenario, reduced or absent eyesight, due to delay in timely treatment of amblyopic conditions, could create major, long-lasting effects on all aspects of life, including daily personal activities, interacting with the community, school and work opportunities and the ability to access public services. Processes coming out of lockdown should be gradually easing restrictions giving priority to ophthalmology and eye care facilities so that amblyopia does not remain unattended and irreversible as in adults due to lack of timely treatments. If not reversible, this process could lead to a dramatic increase in disability and unsustainable social costs for many governments.

Keywords

COVID-19 pandemic, pediatric-eye care, amblyopia, irreversible blindness, ophthalmology, visual impairment

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What is known

- Amblyopia is the most common causes of vision problems in children and it is estimated at 1–6% in different areas.
- It develops during early childhood when the visual system is vulnerable to changes in visual stimulation and it remains as permanent visual defect into adulthood if left untreated.

What is new

- Due to the COVID-19 pandemic, a dramatic reduction in the access to pediatric-eye-care has been observed.
- If not reversible, a delay in timely treatment of amblyopic conditions could lead to an increase in disability and unsustainable social costs for many Governments.

After the World Health Organization (WHO) recognized COVID-19 as a global pandemic on March 11, 2020, widespread changes and restrictions to social and sanitary practices have presented significant issues in access to eye-care during the COVID-19 pandemic.[1] Several national ophthalmology societies have sought to defer any treatment other than urgent or emergency care to contain human to human viral transmission.[2–4] Thus, to deal with rising cases of COVID-19, the outbreak practically brought all clinical activity to a standstill for several-weeks and an increasing need to prioritize access to eye care while broadly maintaining SARS-CoV-2 infection control.[5–8] This poses many risks, delays or suspends non-essential outpatient visits and elective surgical procedures.[9–13] Patient visits and encounters have significantly decreased in many subspecialties, with a loss of more than 81% of annual patient volume for a two-week period in March and April 2020 compared to the corresponding period in 2019 in eye care.[14–16] In our experience, during the first COVID-19 lockdown a reduction of more than 80% in pediatric eye care volume up to its total cessation has been observed in many of our departments. If reconfirmed, this reduction in volume in pediatric eye care is second only to that experienced in cataract surgery volumes, as a consequence of the need to prioritize emergency treatment.[2,15]

To date, no clear European data is available yet on the impact of COVID-19 on pediatric eye care in different National Health Systems. Thus, it is of paramount importance to assess the impact of lockdown on ophthalmological care and its future adverse consequences in terms of disability and access to vision-saving cures for many pediatric patients. To address this challenge, we have brought together EUROCOVCAT (European COVID-19 Cataract Group), a group of ophthalmic surgeons, specialists including pediatric ophthalmologists and experts from 12 European countries, to discuss how to resume practicing ophthalmology in the safest and most efficient manner, and reduce the risk of eye diseases such as amblyopia. The group is also creating awareness among national governments to allow ophthalmology practices to remain open during lockdown to minimize unnecessary sight-loss, particularly in vulnerable children in visual development. EUROCOVCAT has organized conferences and calls sharing fruitful experiences and perspectives on the current context. An in-depth analysis of the current situation in pediatric eye care has been merged with the updated literature and available recommendations from scientific ophthalmic societies and healthcare institutions. Here we summarize some recommendations practical hints and key steps for the reorganization of pediatric care management and reorganization during the time of COVID-19, merging the experiences of the European COVID-19 Cataract Group (EUROCOVCAT) including the most update published literature and guidelines. Additionally, new perspective and solutions are provided to the health providers to facilitate and coordinate their cooperation with in- and out-patient clinics.

Bangerter has defined amblyopia as an underfunctioning caused by deprivation.[17] Accordingly, one eye remains impaired and sends altered signals to the brain. So, the patient uses the 'good eye' or normal eye for all activities. This affects depth perception or stereopsis that require healthy functioning in both eyes. Amblyopia presents low visual acuity without any apparent abnormality of the visual pathway in one or both eyes and cannot be immediately resolved by wearing glasses.[18] The term is used most frequently to refer to the unilateral condition, although amblyopia may be bilateral.[18] Refractive correction cannot reverse and cure the disease in adults, as after the age of about 10 years, it cannot be fully reversed.[19–21] Amblyopia is categorized into three types: strabismus (squint), stimulus deprivation such as cataract or ptosis, and anisometropia.[18]

Amblyopia develops rapidly during early childhood (birth to 8–10 years of age) when there is inadequate visual stimulation in one eye as optic signals do not properly reach the brain.[22] It remains a reversible condition[18] and varies in incidence based on regions and age groups. In children, impaired vision from birth or in early childhood can have a negative effect on their growth and development if left untreated or not treated in a timely manner. Indeed, a low vision in childhood may lead to inadequate emotional and social development of the child with severe adverse long-term social, psychological, and financial consequences for the families.[23–26] Indeed, untreated amblyopia rarely gets resolved spontaneously.[27] About one-fourth of the population of people with amblyopia have visual acuity in the affected eye worse than 20/

100.[28] There is significant neural plasticity in the amblyopic brain beyond the critical period.[25]

Baseline and clinical factors such as the initial visual acuity, type of amblyopia, treatment initiation age, the efficacy of the treatment modality and patient's compliance are key factors affecting the outcome.[18,29] Hence, appropriate timely treatment during the critical period mitigates adverse outcomes later. Although many ophthalmological treatments are elective with scheduled visits or surgeries and may be postponed without any major impact on public health, the pediatric treatments should not be postponed as prolonged vision loss during formative periods is irreversible.

Amblyopia may remain asymptomatic and undetected for years to the parents or the impacted child, because they typically have good visual acuity in the normal eye. Therefore, during the preschool period, many children remain undiagnosed because their eyes appear normal initially until school admission.[18] Accordingly, it is readily predictable that any delay or suspension in essential pediatric eye interventions or procedures may cause significant and rapid vision impairment to irreversible vision loss in younger generations.

Some authors have already highlighted the silent impact of increasing usage of digital devices on children's eye health during the ongoing COVID-19 pandemic.[30,31] Before the COVID-19 outbreak children were growing up in a highly visually demanding world where electronic devices, e-readers, tablets, video games, and the ubiquitous mobile phone were exploited for entertainment and leisure. Increased digital screen time, near homework, and limited outdoor activities were found to be associated with the onset and progression of myopia, and can potentially be worsened during and beyond the COVID-19 pandemic outbreak period.[30,31] Additionally, the diffusion of e-learning has recently increased the use of electronic devices as tools for long-term daily use, leading to an exponential increase in digital eye strain (DES), making it an emerging public health problem with a reported prevalence of more than 50% among children in the COVID era.[32]

Jayadev et al. have reported that approximately 80% of outpatient visits in the pediatric ophthalmology department in March and April 2020 (at the start of the lockdown) were for refractive errors, of which 79% were for myopia.[33] Nowadays with no definitive end in sight for the pandemic, we are potentially facing scenario of 'quarantine myopia' which is potentially explosive. There are predictions of a worsening of the myopic epidemic worldwide and is estimated that over 50% of the world's population will have myopia by 2050.[34,35] Recently, a prospective study designed to investigate the refractive changes and prevalence of myopia in school-aged children during the COVID-19 home confinement in 123,535 children aged 6 to 13 years, has reported a significant myopic shift for children aged 6 to 8 years of approximately −0.3 diopters in China.[30] These results are consistent with the data of another large-scale intervention study with 12-month follow-up on myopia development among 1,001,749 schoolchildren of 1305 elementary and high schools. Here, myopia increased approximately 1.5 times from −0.23 D during the pre-COVID-19 to −0.343 D during the post-COVID-19 period.[36] Moreover, even if data are still controversial, besides myopic progression, accommodative dysfunction in children may be also on the rise due to digital device usage.[37,38] Accommodation spasm and sudden onset esotropia are important consequences.[39] The former presents with an acute, rapid increase in myopia and requires dynamic, cycloplegic retinoscopy, and a comprehensive assessment of the binocular visual field.[33] Receded near the point of convergence, large near exophoria, reduced near the point of accommodation, and lag of accommodation greater than +1.25 diopter sphere demand further assessment for non-strabismic binocular vision dysfunction.[40] Vision therapy may play also a significant role in managing these anomalies.

With this information in mind, and to avoid any increase in the incidence of amblyopia, some authors have already proposed evidence-based recommendations on how to adequately evaluate children during the amblyopic period while reducing COVID-19 transmission.[41,42] We believe that the following recommendations should always be implemented in all cases of suspected pediatric amblyopia or myopia (Figure 1):

- If the child has already been screened and a diagnosis of amblyopia has been made, the treatment should be continued and the appointment to monitor the ametropia may be postponed without any additional risk;
- If the child has not been seen and a decreased visual acuity or strabismus is suspected, he/she should be seen to eliminate an organic cause or the risk of amblyopia, especially if under six years of age;
- If strabismus has already been diagnosed, an alternating or unilateral occlusion depending on the case should be started and maintained according the last ophthalmological consultation and until the next one; this treatment renewing may be carried out via telemedicine;[43,44]

In any case, all children should be seen urgently to eliminate an organic cause (e.g. retinoblastoma, tumors, congenital glaucoma, infection, traumatic lesion of ocular adnexa.) if under two years of age or with an acute onset of strabismus or recent nystagmus or suspicious/obvious organic problem (leukocoria, buphthalmos, megalocornea, tearing, photophobia, red and/or painful eye, or trauma).

So far, we have limited data to accurately predict the future course of the COVID-19 pandemic. Even though many governments have already started easing the

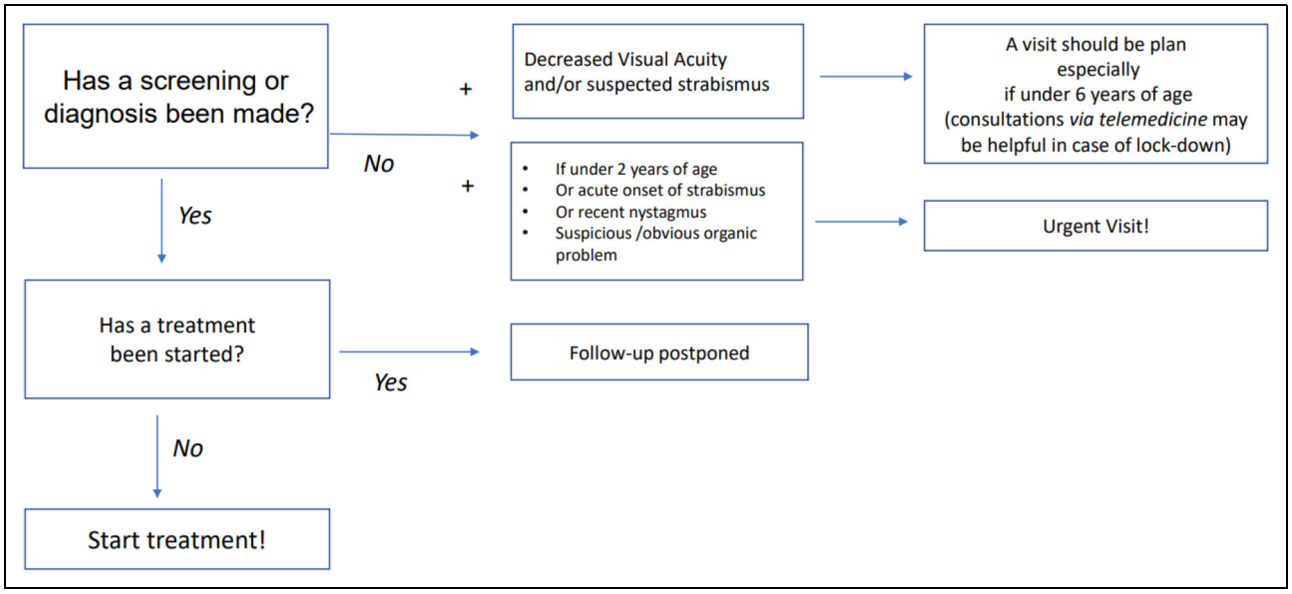

Figure 1. Flow-chart of amblyopia management.

current stringent lockdown measures, the current phase may last several months. Additionally, the diffusion of vaccines could prove beneficial in conditioning the return to normal life and provide effective responses to a potential COVID-19 resurgence. If pediatric patients are not treated in a timely manner, limited healthcare facilities might be overburdened with large number of cases not being attended currently due to lockdown and eye care facilities being converted into corona wards/hospitals in Europe.

In this scenario, reduced or absent eyesight caused by the delay in timely treatment of amblyopic conditions could create major and long-lasting effects on all aspects of life and affects daily personal activities, such as interacting with the community, school and work opportunities and the ability to access public services. Amblyopia could prove costly and serious in the long run if patients are not attended immediately,[18] especially in the vulnerable young age of up to 8 years, when cortical and optical nerves connecting the brain and abnormal eye develop completely. If not reversed, the limited access to sight-saving cures for many pediatric patients could lead to harmful consequences in terms of even permanent disability in younger generations. Therefore, achieving a delicate balance between infection control and the supply of ophthalmology services to properly diagnose and treat childhood amblyopia is strongly recommended and suggested to avoid unsustainable social costs for many health care systems. Processes coming out of lockdown should be gradually easing restrictions on priority on eye care facilities (hospital/clinics) so that amblyopia does not remain unattended and irreversible as in adults due to lack of timely treatments. Adult low vision leads to a costly visual impairment reducing access to professional activity. Additionally, as eye health care providers, we need to promptly identify those children, if necessary, using telemedicine, who are at a higher risk of DES and progression of myopia to manage them appropriately. A public awareness campaign to improve safety measures, enhance early detection of DES, and promote prevention and screening measures in our young citizens is strongly needed. Presently, different screening tools are employed to assess the visual status of children. Vision screening for school-age children is important to detect uncorrected refractive errors.[45,46] A WHO study has recommended that the screening of children for refractive errors should be integrated into school health programs and could be carried out by government and non-governmental organizations as well.[47] Pediatric health care providers will need to screen and treat children and counsel their parents and/or other caregivers during well-child visits with an eye care practitioner for these new or worsened environmental threats. It is crucial to make teachers and parents aware that these practices can help to check the growing ill-effects of lockdown.[33,48] Restriction of online classes with breaks in between sessions, promoting (permitted) outdoor activities, encouraging "family" time with non-gadget-based learning and entertainment are some measures that can be adopted. Favoring care to those of higher socioeconomic means, those with better access to care, and perhaps even of different race groups, is also a priority[49] to make care more equitable.

In this scenario, telemedicine delivered both in an asynchronous or synchronous manner, may be a new tool able to deliver inpatient and outpatient pediatric care, educate pediatricians and patients' families, and conduct medical research during the COVID-19 emergency.[43,44,50] Indeed, with proper materials, technology, and staffing, telemedicine can be rapidly implemented to provide

continued patient care during pandemic conditions.[2] It can also provide access to pediatric care to remote and underserved populations, considering its costs and sustainability, and the actual lack of technology infrastructure on a national scale. Ophthalmology relies heavily on objective assessments through examination techniques and investigations. Some techniques lend themselves to widely available smartphone and web-based technologies. These include visual acuity examinations, contrast testing, color vision testing, optical axial length and gaze photography. However, most of them are sophisticated examinations that must rely on specialized equipment with trained personnel to obtain standardized images. Nowadays, a multitude of smartphone extensions have been developed to obtain retinal imaging and are being systematically evaluated in some ocular diseases. However, for most of these applications, parameters around safety, efficacy, cybersecurity, privacy, and interoperability still need to be carefully tested before their approval.[50]

Abbreviations

EUROCOVCAT European COVID-19 Cataract Group

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Supplemental material

Supplemental material for this article is available online.

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